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THE CULTIVATION OF TOBACCO IN KENTUCKY AND TENNESSEE.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., November 5, 1908.

SIR: I have the honor to transmit herewith a paper entitled "The Cultivation of Tobacco in Kentucky and Tennessee," by Messrs. W. H. Scherffius, Collaborator, and H. Woosley and C. A. Mahan, Special Agents, Tobacco Investigations. I recommend that this manuscript be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE CULTIVATION OF TOBACCO IN KENTUCKY AND TENESSEE.

INTRODUCTION.

Tobacco belongs to the order of plants commonly known as the nightshade family. Its generic name, "Nicotiana," was given to it in honor of Jean Nicot, French ambassador to Portugal in 1660. When, two years before this, specimens of tobacco had been brought from Mexico to Spain, Nicot secured some of the seeds and sent them to Paris.

There are fifty or more species of the genus Nicotiana, though few of them enter into the commerce of the world. The species grown in the Ohio Valley, the one of chief importance, is *Nicotiana tabacum*. The aborigines of America grew tobacco long before the advent of the white man. The French explorers Marquette and La Salle found it in cultivation and use by the Indians along the Mississippi and Ohio rivers and their tributaries as early as 1669 and 1673. In 1750, nearly one hundred years later, Capt. Christopher Gist, an agent for the "Ohio Company," came down the Ohio River and found tobacco being grown by a tribe of Indians at Shawneestown, the present site of Portsmouth, Ohio. During this same time tobacco was being grown by the Shawnees at the present site of Indian Fields, Ky., in Clark County.

In 1775 white pioneers migrating westward from Virginia and North Carolina made a permanent settlement at Boonsboro, Ky. Being familiar with the handling of tobacco and its value, they immediately began growing it along with other crops. Soon after the founding of Boonsboro the price of tobacco increased rapidly, which encouraged the tobacco farmers of Virginia and North Carolina to migrate into this new and fertile territory. As early as 1792, when Kentucky was admitted into the Union, settlements were being established throughout the States bordering on the Ohio River. Following the custom in Virginia, tobacco became a medium of exchange. After home consumption had been supplied the surplus was shipped down the Mississippi to New Orleans for exporta-

tion. The French settlers of the Illinois country had there been following this method of disposing of their surplus for nearly a quarter of a century. As the population increased, the demands of the home market likewise increased, and in a short while establishments were located at Lexington, Ky., and other points for the purpose of manufacturing plug and twist tobaccos for home consumption. A steadily increasing demand on the home market developed, while the export business dwindled to nothing and was not revived until after the close of the civil war.

In 1866 a very important discovery pertaining to tobacco was made by Mr. George Webb, a farmer living in Brown County, Ohio. He noticed in his field of tobacco some plants which were light green in color, with cream-colored midribs and stalks. The seed which had produced this type was furnished to Mr. Webb by the United States Commissioner of Patents, in whose office at that time the distribution of seeds under Government auspices was conducted, and these plants were probably mutations, or sports, due to the effect of change in soil or climatic conditions. They were so different in appearance from those which produced red tobacco that Mr. Webb carefully preserved them and saved the seed. It was noticed that tobacco from this selection of seed gave a brighter cured product than the original red tobacco from which it was obtained. The new type of tobacco gained favor rapidly on account of its mild quality and bright silky appearance, and its cultivation soon spread over what is known as the White Burley district. This type now supplies the market with chewing, cigarette, pipe, and cigar tobaccos, but the greater part of it is manufactured into chewing tobacco.

The dark-tobacco district, including western Kentucky, part of western Tennessee, a small area of Missouri, southern Illinois, and southwestern Indiana, produces a dark, heavy type, which is principally exported to European countries.

In view of the fact that Kentucky and the bordering States produce 376,647,000 pounds annually—one-sixth of the total production of the world, and more than one-half of the production of the entire United States—of a quality of tobacco which is peculiarly confined on account of soil and climatic conditions to this area, we may expect that a great part of the world will continue to look to this western section for supplies for its consumption.

Much has been written in recent years in regard to the improvement of the tobacco plant by breeding and seed selection, but little reference has been made to the actual field operations employed in the cultivation of the crop in this western section. It is the object of this bulletin to present the best methods of cultivation now in use, with detailed descriptions of the principal operations employed.

THE PLANT BED FOR TOBACCO.

The plant bed should be located on some well-drained spot, with southern and eastern exposure if possible. This gives the maximum amount of sunshine and a protection against the cold northern and western winds. It is a common practice to select a place in the woods where the soil is loose, friable, and rich in humus, but in sections where wooded tracts are scarce plots covered with brier patches or a heavy growth of shrubbery often found in abandoned fields make desirable locations. A good substitute for virgin soil and one often used in the White Burley district is a field bearing a heavy growth of bluegrass sod, but cultivated lands do not give as good results and should not be used if it can be avoided. A few successful farmers use the same bed for several consecutive years. In such cases an application of barnyard manure and tobacco stems or stalks should be made in the fall. During the winter the soluble elements are removed by leaching and carried into the soil. When the time for burning has arrived, the manure and stems are raked off and heaps of waste wood and brush are piled on the bed and burned.

In case the barnyard manure and tobacco stems or stalks have not been previously applied, an application of high-grade commercial fertilizer, one containing, say, 10 per cent of potash, 4 per cent of nitrogen, and 10 per cent of phosphoric acid, all in an available form, will give good results. It should be applied at the rate of 100 pounds for every 1,500 square yards. Commercial fertilizers are not extensively used. The farmers as a rule depend entirely upon the natural fertility of the soil to produce the desired growth in the young plants before transplanting.

The preparation of the seed bed is of such importance that neither time nor labor should be spared in making all of the conditions first class. Neglect to have plenty of good plants necessitates the curtailment of a crop and may result in its complete failure.

The main object in burning the bed, so far as the writers can see, is the destruction of weed seeds which would otherwise produce weeds to interfere with the growth of the young plants. Most of the weed seeds are lodged in the upper 2 inches of the soil, and their vitality is readily destroyed by burning or heating the bed. Some mineral plant foods, such as potash salts, are rendered more available by burning, which adds to the store of available potash in soils. On the other hand, organic matter is largely destroyed by the burning, which is detrimental to the extent that it liberates some of the nitrogen, thus reducing the amount available for plant food, and also reduces the moisture-holding capacity of the soil by destroying a part of the humus.

The scarcity of wood has caused the advent of a tobacco bed burner, which is a movable device especially designed for burning plant beds. The furnace is 3 feet wide and 9 feet long and is arranged with a pan on which the soil is placed and roasted for about an hour. The fire is fed under one end, similar to the way an evaporating pan is heated in making molasses. A block of soil 9 feet long, 3 feet wide, and 2 inches deep alongside of the furnace is shoveled into the hopper. During the heating it should be turned over two or three times with a long-handled shovel. The roasted soil is then shoveled out of the hopper back into the hole from which it was taken. This same operation is repeated with the soil on the other side of the furnace. By the time this second block of soil is roasted the soil covered by the furnace is likewise sufficiently heated. Hence, at each setting, a space

FIG. 1.—Tobacco bed burner in operation.

of 9 feet by 9 feet is burned. Reference to the illustration (fig. 1) will give a good idea of how the furnace is constructed.

Under ordinary circumstances, 45 to 50 square yards of ground can be burned with this furnace in a day. If a stiff wet clay is being dealt with, more time will be consumed in burning and the area covered in a day will be correspondingly lessened. The principal advantages of the furnace are that the ground can be burned while wet without fear of baking except in the area directly beneath the furnace, a more uniform and thorough burning may be secured, more weed seeds are destroyed, and less wood is required. The furnace is made of sheet iron throughout, costs about $35, and is serviceable for several years. This type of furnace has been in use for four or five years, but has not come into use by a majority of the farmers.

The bed may be burned at any time from November to the last of March. A few farmers burn in the fall, a desirable practice in many respects. The weed seeds are then on top of the ground and the soil is likely to contain less moisture, so that much less fuel is required. Most beds are burned by the open-fire method during February and March, as weather conditions are favorable at that time. It is preferable to have the soil as dry as possible in order to avoid baking in burning and to economize time and fuel. If much water has to be evaporated from the soil unnecessary delay is experienced.

A few farmers sterilize their beds with steam.[a] In this case a steam box of the desired dimensions is constructed and placed over the selected spot, a boiler for supplying the steam being used. Sufficient pressure to destroy all weed seeds can be easily maintained. Beginning with 120 pounds of steam it will be reduced to about 90 pounds in a single operation. While this method of sterilizing has not come into general use, those who have tried it pronounce it a complete success. After the bed is sterilized it is thoroughly worked to a depth of from 2 to 4 inches with hoes, rakes, and disk plows or harrows.

It is a common practice to raise the level of the bed a little above the surrounding surface by bedding; also to leave 12-inch valleys around the bed and have them cross the bed at intervals of from 6 to 12 feet. This gives good surface drainage. After the soil is

[a] The method of steam sterilization of tobacco seed beds in the Connecticut Valley, devised by Mr. A. D. Shamel, of the Bureau of Plant Industry, and now in practical and successful use in that region, is as follows: A steam pan is made of sheet iron, 10 feet long, 6 feet wide, and 6 inches deep. Attachments are made which provide for the introduction of steam into this pan and for the connection of the steam hose or pipe running from the steam boiler to the pan. This steam hose should be at least 1 inch in diameter and 50 feet long, so as to permit the supply of an abundance of steam and in order that the box may be moved without moving the steam boiler.

The soil for the seed bed is fertilized and prepared in the same manner as for the sowing of the seed. The pan is turned over a section of this prepared soil and care taken that the edges of the pan sink into the loose soil, so as to prevent the loss of steam under the edges of the pan.

The steam is now turned into the pan, and on being confined under the pan under pressure it rapidly heats the soil to the desired depth. A strong pressure should be maintained in the steam boiler and a full supply turned into the pan.

In the beginning the temperature of the heated soil should be frequently determined. It is desirable to heat the soil to 175° F. to a depth of at least 4 inches and to maintain this temperature for about one hour. This treatment destroys the weed seeds and diseases in this soil and improves the condition of the seed-bed soil for the growth of tobacco seedlings.

About 600 square feet of seed-bed surface can be treated in one day according to this plan. The tobacco seed should be sowed the following day and lightly raked in.

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thoroughly prepared, the seed is sown; in the Burley district at the rate of 1 teaspoonful to every 200 square feet; in the dark district at the rate of 1 teaspoonful to every 300 square feet. There is no good reason for this difference; custom has established these measures.

In view of the fact that the seeds are so small, a sufficient quantity to sow a bed is mixed with one-half gallon of fertilizer, ashes, dirt, or corn meal, so that the sower may secure a more even distribution of them. They may be settled into the ground by rolling, trampling, or lightly raking over the bed.

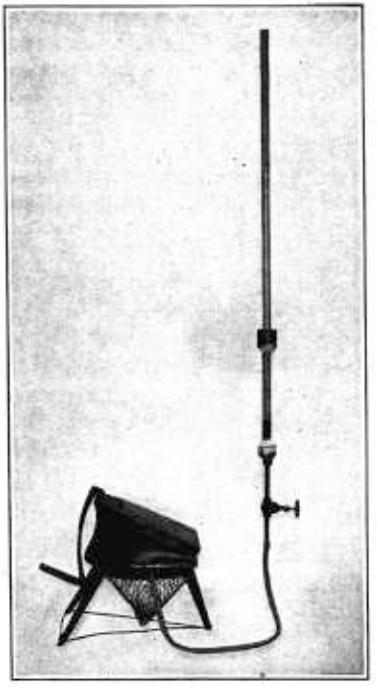

FIG. 2.—Tobacco seed grader for separating heavy from light seed, devised by Mr. A. D. Shamel, of the Bureau of Plant Industry.

During the winter months before sowing time the seed should be graded in a tobacco seed separator, like that shown in figure 2, which will remove all the light and immature seeds. The importance of good seed in every crop has been demonstrated so often that every farmer should know that it pays him well to sow only the best. It has been demonstrated here and elsewhere that the lack of uniformity in our tobacco fields is largely due to poor seed. (See fig. 3.)

Sowing should not be made later than April 1. Beds sown from January to April produce plants for setting by May 15 to June 10, which is usually the best time. If the weather conditions are such that sowing can not take place until late, the seeds can be partly germinated by mixing the quantity to be sown with sand about ten days previous to sowing. The sand should be kept moistened and in a warm place. If the mixture is kept in a very favorable situation, it is not desirable to extend the soaking period more than ten days. The tobacco seed coat is comparatively thick and hard to break, however, and usually three weeks are required before complete germination takes place.

CARE OF THE BED.

To secure rapid growth of the young plants and to afford protection from frosts it is necessary to use a covering, which is usually made of ordinary cheese cloth. The bed is boxed up by using 1-inch

boards placed on edge, extending all around the bed. Wires are stretched across or pegs or wickets are put down a few feet apart on the bed and arranged to hold the canvas a few inches from the ground. The widths of canvas are sewed together to fit the bed, and are

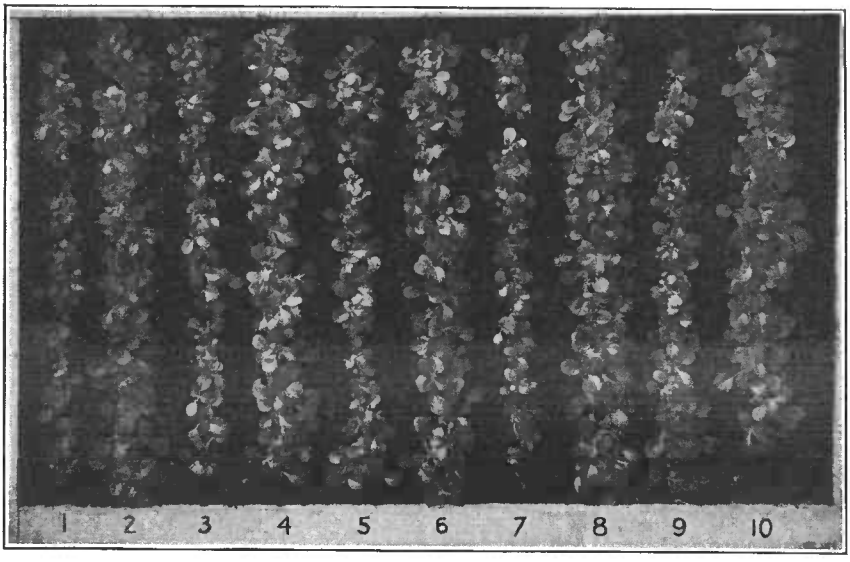

FIG. 3.—Tobacco plants in germinating box. Those from heavy seed are indicated by even numbers; those from light seed, by odd numbers.

stretched over the bed and tacked to the surrounding plank (fig. 4). Any open spaces that may occur under the boards are filled by banking the earth against the boards. By this method the heat of

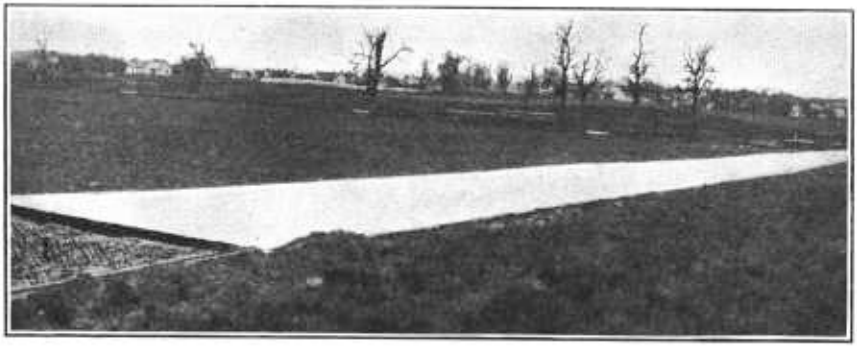

FIG. 4.—Tobacco plant bed with canvas stretched over it.

the bed is considerably increased, especially at night, as the canvas prevents much of the rapid radiation which would otherwise take place. During drought the bed becomes excessively dry, and it is often necessary to water it two or three times a week. The bed should

not be soaked with water, but should be thoroughly moistened. The best time for watering is late in the afternoon, to avoid baking the soil or scalding the plants.

The canvas should remain on the bed until about ten days prior to transplanting, when it should be removed, in order that the plants may become more hardy and accustomed to field conditions. If the canvas remains on too long it is commonly conceded that excessive leaf growth and too little root growth result. If the plants are growing very rapidly and give indications that they will be ready for transplanting before the desired time, the covering can be removed earlier than indicated; this will to some extent check their growth.

Insect pests sometimes cause considerable injury to the young plants. In the bed they can be controlled by the use of arsenate of lead—8 pounds in 100 gallons of water, applied with a spray pump. This insecticide does not injure the plants in any way and adheres to the foliage very well, being superior to Paris green in this respect.

SELECTION OF SOIL FOR THE CROP.

In the Burley district virgin soil is preferred for the crop. White oak, beech, walnut, maple, and hickory clearings are famous for the production of tobacco having very fine quality. The yield, however, on these newly cleared soils is not equal to that on old land in a good state of cultivation. Tracts of land that will produce good tobacco are limited even in the principal tobacco-growing districts. The average farm usually contains only a small area of land that is particularly adapted to tobacco. The soil should be fertile, friable, and abounding in organic matter to produce the best results. Very little virgin soil remains available for cultivation; consequently, tobacco growers are compelled to adopt a substitute. Bluegrass sod produces a fine quality of tobacco and gives a good yield. Clover sod gives a good yield, but the tobacco does not have the bright color that is secured from the bluegrass sod. Timothy sod is also used for tobacco, but it is not as good as those already mentioned.

No fixed and unchangeable method of rotation is practiced, though some general principles are observed with reference to preceding and succeeding crops. The usual plan of rotation is to have tobacco follow a sod of bluegrass, clover, or timothy and in turn be followed by winter grain, such as wheat, rye, or turf oats. Tobacco follows tobacco for two or, perhaps, three years when virgin soil or bluegrass sod that has not been cultivated for several years is used. The crop of the second year is usually superior to that of the first year in that it has better body and more weight. The third-year crop is often disappointing unless the soil is very fertile in the beginning. It is generally believed that six or eight years of bluegrass sod are re-

quired to restore soil to its native productive capacity, particularly with reference to the quality of the tobacco produced. Farmers who make an effort to grow a fine quality of tobacco and at the same time maintain the fertility of the soil practice the sowing of bluegrass along with clover and timothy in wheat following tobacco. In three or four years the bluegrass practically replaces the clover and timothy and will maintain a sod indefinitely. After the field has been used for three or more years for pasture it is again available for tobacco. Below is shown how this eight-year rotation is carried out. The grass or clover printed in italics is the predominant one for the particular year shown. It is assumed that a fertile virgin clearing or bluegrass sod is used to begin with.

(1) Tobacco.
(2) Tobacco.
(3) Wheat.
(4) *Clover, timothy*, bluegrass.
(5) *Clover, timothy*, bluegrass.
(6) *Timothy*, bluegrass.
(7) Timothy, *bluegrass.*
(8) Bluegrass.

Bluegrass is slow in forming a heavy sod. Advantage of this is taken by securing two crops of clover and timothy. When a four-year system is in vogue the rotation outlined below is common:

(1) Tobacco.
(2) Wheat.
(3) Clover and timothy.
(4) Clover and timothy.

To give an accurate idea of soil requirements, Mason County, Ky., may be taken as a fair representative of the Burley district. It is especially selected for illustration because it is included in the Hagerstown clay formation district, which is probably the finest tobacco-growing section of the country. The soil is a heavy brown or pale yellow loam resting on a stiff yellow clay. The Hagerstown clay was formed by the decomposition of limestone of the Upper Hudson of the Lower Silurian era. On the flat tops of some of the hills and on virgin forest areas a loose brown loam may be found. At one time the Hagerstown loam in all probability covered the area now occupied by Hagerstown clay. Continued erosion has carried the greater part of the surface soil away and in many sections the exposed limestone is outcropping. This section of the country is decidedly rolling, and frequently hills with an elevation of considerable magnitude are seen. This land produces on the average about 1,000 pounds of tobacco to the acre.

In the dark-tobacco district, virgin soil on beech, maple, hickory, white oak, red oak, and black jack clearings produces the finest quality of tobacco and is preferred to old land even though it be in a fine state of cultivation. As in the Burley district, clearing has gone on until a relatively small percentage of the land remains in forest. Farmers who have no virgin or "fresh" land to put in

tobacco usually prefer clover sod to anything else. Frequently tobacco follows corn and seems to give good results.

Perhaps a definite rotation is more strictly observed in the dark district than in the Burley district. In some localities the following rotations, which have nothing in particular to commend them, are practiced:

(1) Tobacco.	(1) Tobacco.
(2) Wheat.	(2) Wheat.
(3) Wheat.	(3) Clover.
(4) Clover.	(4) Corn.

The use of some leguminous crop is particularly needed throughout this district. Hairy vetch (*Vicia villosa*) could be used to good advantage as a winter cover crop where tobacco follows tobacco. It is a leguminous crop, gathers nitrogen from the air, and grows well in some localities of the dark-tobacco district. It should be sown early in the fall at the rate of half a bushel of vetch and half a bushel of rye to the acre, or, if preferred, some other winter grain may be used. Vetch produces a trailing vine which must be supported by some other crop; if the vetch is to be plowed under in early spring before a very rank growth is attained, however, but little winter grain will be needed to support it.

A typical soil in the dark-tobacco district is that of Montgomery County, Tenn. This Clarksville silt loam of Montgomery County is a residual soil, formed by the decomposition of St. Louis limestone. The action of the air and water dissolves the calcium carbonate, leaving behind the insoluble portions of the rock, which disintegrate to form soil. The surface of this soil has a grayish, very fine silty texture. The subsoil is a yellow loam containing considerable silt and some clay. For some localities in this section a considerable quantity of chert is present, which aids in drainage. Underneath the loam subsoil is a heavy impervious red clay. This serves as a reservoir to hold in reserve moisture for growing crops in time of drought. The surface is somewhat irregular; besides being rolling there are numerous depressions caused by old sink holes. These are usually porous enough in the bottom of the basin to secure good drainage.

The soil and climatic condition of Montgomery County, Tenn., seem to be most favorable for the production of that fine, dark, export type of tobacco so highly prized in European countries.

A more complete discussion of the soil types may be found in the reports on the soil surveys of Mason County, Ky., and Montgomery County, Tenn., by the Bureau of Soils of this Department.

TIME TO BREAK THE GROUND.

Virgin soil where heavy clearings have been made and where there is no grass to contend with may be broken in the spring, sufficient time being allowed to put it in good tilth before planting.

Bluegrass sod and hillside land are usually broken in the spring. The former may be broken in the fall, and in any case should be broken early enough for rotting of the sod to take place before transplanting time. The sod should be turned under so deeply and thoroughly that in case it is not completely rotted it will not be pulled to the surface by subsequent cultivation. Clover and timothy sod should be broken in the early spring. In that way it serves as a winter cover crop for the land and is sufficiently rotted to be out of the way by planting time. Where tobacco follows corn the ground is usually broken in the spring, early enough to keep down a growth of vegetation. Where tobacco follows tobacco a cover crop of rye, winter or turf oats, or barley should be sown. This must be turned under sufficiently early for the green crop to rot. Frequently tobacco follows tobacco or tobacco follows corn and the ground is allowed to go over winter without any kind of cover crop, but this is a bad system and should not be practiced.

FERTILIZERS.

Where fertilizers are to be used, it is best for farmers to buy the ingredients and do their mixing at home. This is less expensive than buying the commercial goods, and by doing their own mixing the farmers familiarize themselves with the amount of plant food in the raw materials. By acquiring this knowledge they will be better posted as to their intelligent use. If a commercial or mixed fertilizer is to be bought it is best to buy a high-grade article, one running high in those elements in which the soil is deficient. The low-grade and low-tonnage-price fertilizers are the most expensive. Farmers pay on the average 2 cents a pound more for plant food—nitrogen, potash, and phosphoric acid—in a low-grade fertilizer than for that in a high-grade fertilizer. In some instances they pay as much as 6 cents a pound more for plant food in a low-grade fertilizer than they have to pay for it in a high-grade article, besides having to pay twice the amount for freight, sacks, and mixing to get the same quantity of plant food.

In the Burley district, where the tobacco is usually set about 18 inches in the drill, the fertilizer is scattered along in the rows, but where the tobacco is checked the fertilizer is dropped in the check. Fertilizers are sometimes applied broadcast, which is a better practice than the methods usually employed. A quicker start may be had by hill fertilizing, but a better season's growth should be produced by broadcasting, especially if the crop passes through a drought, as placing concentrated, quick-acting, soluble fertilizers too close to the roots of the young plants may injure them.

In the dark-tobacco district the usual practice is to set the tobacco in check rows and apply the fertilizer in the checks. If a drought

occurs during July or August, hill-fertilized tobacco will fire worse than that broadcasted, for the reason just mentioned. The fertilizer usually gets the blame for this, while the fault lies in the method of application rather than in the fertilizer.

It is impossible to prescribe a fertilizer formula for tobacco suited to all conditions. Varying quantities of potash, nitrogen, and phosphoric acid may be required, depending on the fertility of the soil and the kind of season. By reference to Bulletin 66 of the Kentucky Agricultural Experiment Station, it will be seen that an application of potash or potash and nitrogen gives good results in the limestone region, while in western Kentucky, where the soil is deficient in phosphoric acid, actual field tests have shown that an application of phosphoric acid gives good results.

Tobacco is sometimes regarded as a potash plant, in that 1,000 pounds of crop take more potash from the soil than is taken by the same number of pounds of most crops; in fact, tobacco removes several times as much as is taken by the common crops, such as corn, wheat, cotton, and hemp. Sulphate of potash is found best adapted for tobacco. The chlorin in muriate of potash is considered injurious to both the growing plant and the manufactured article. Tobacco stalks make a valuable manure and should be hauled out and turned under in the early spring. Barnyard manure is not to be recommended where a fancy, highly colored Burley tobacco is to be produced. It can, however, be used to good advantage where a great deal of weight and body is demanded. Generally speaking, barnyard manure has a tendency to produce a coarse tobacco.

PREPARATION OF THE SOIL.

After breaking, the soil should be thoroughly harrowed and rolled, in order to reduce all clods and leave the surface smooth and mellow.

If a crust should form before transplanting, a light harrow or weeder should be used to break it. This prevents the soil from becoming dry and hard, stops excessive evaporation of moisture, and less rain will be required to afford a season suitable for transplanting.

Laying off the ground is the final operation before transplanting. A good implement for doing this is a marker constructed similar to the one shown as figure 5. A marker 7 or 8 feet long will mark off three rows in one drive. The indicator arm makes a slight mark sufficiently distinct to center with the tongue on the return trip. The arm is so constructed that it can be reversed to the other side on the return trip. For setting tobacco where it is desirable to have it 18 inches in the drill, the marker shown in the cut will lay off five rows and insure an equal number of plants to each drill. This implement does not furrow the ground; it only makes distinct crosses and the plants are set in the crosses.

In the Burley district the plants are set in rows 3½ to 4 feet apart and usually from 18 to 24 inches in the row. A greater distance between the plants, especially on rich soils, produces a coarseness of fiber that is undesirable. Plants set on poor soils should be farther apart than those on rich soils in order to secure the desired growth.

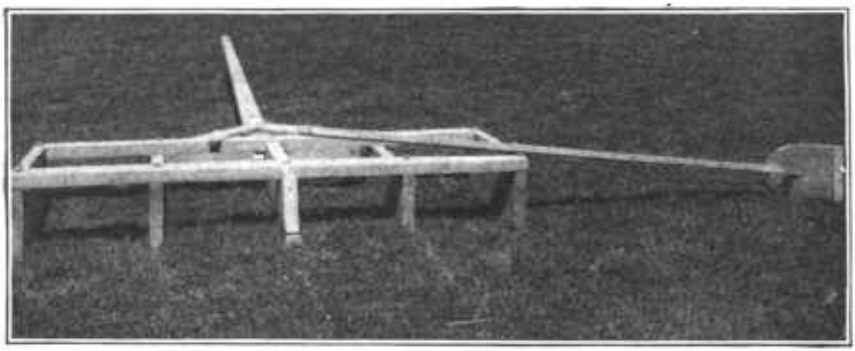

FIG. 5.—Marker used for laying off the rows for tobacco plants.

In the dark belt the common practice is to plant 3½ to 4 feet each way and cultivate in both directions.

The old method of transplanting by hand is still exclusively used in some localities. The accompanying illustration (fig. 6) shows the style of peg commonly used in setting the plants.

A 2-horse tobacco setter is used to some extent, especially where there are large fields. With this machine about 3 acres a day can be set, three men and a team being required for its operation. Its greatest advantage is that the crop can be set regardless of season. Growers claim that a larger percentage of plants will live when set by a planter than when set by hand.

FIG. 6.—Peg used in transplanting tobacco seedlings.

A strict rule of procedure for the cultivation of tobacco would be valueless, since soil and climatic conditions are so varied in the different sections of the country. Then, too, farmers have different kinds of tools and each one will adjust his methods to suit his supply of farm machinery. Only a general plan of procedure will therefore be suggested.

At first, use is made of a shovel cultivator or turn plow (fig. 7), run rather close and deep, the object being to stir the soil near the roots so as to admit air and warmth. Subsequent cultivation consists of shallow plowing for the purpose of preventing the growth of weeds and conserving soil moisture. The use of any tool that will

carry out this purpose will give good results. The hoe is not used in tobacco cultivation so much as formerly unless the hills become infested with grass and weeds. It is used very little in the Burley district. Hilling, following the last plowing, is still considerably practiced in the dark-tobacco district. There is a common impression that it produces a heavier tobacco. Cultivation is not continued to any extent after the plants have grown so large that they would be injured from broken leaves and disturbed root systems.

TOPPING.

When fourteen to eighteen leaves appear on a plant of the Burley type or ten to fourteen on one of dark tobacco, the top is broken out so that the leaves will spread and attain the proper body and thickness.

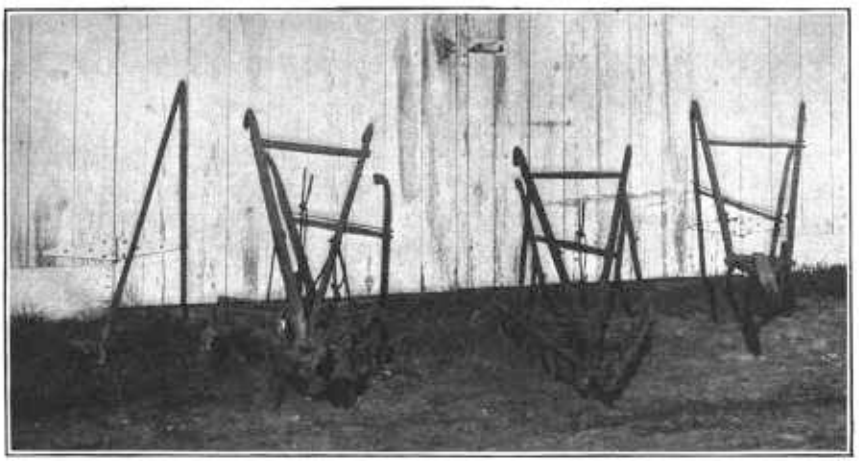

FIG. 7.—Implements used in the cultivation of tobacco.

Topping requires considerable discrimination on the part of the grower. He must be able to judge the capabilities of the individual plant and also the soil in which it grows. A slow-growing plant should not be topped as high as a rapid grower. The former will not mature as many leaves as the latter. For the same reason, plants grown on poor soil should not be topped as high as those grown on rich soil. Good judgment should be exercised in topping the plants so that they will all produce leaves of equal body, all of which will ripen at the same time. This end, of course, can be attained only approximately. High topping tends toward late maturity. An experiment on Burley tobacco at the Kentucky Agricultural Experiment Station in 1906 gave best results when the plants were topped at fourteen to sixteen leaves. The plots used had been in bluegrass sod for a number of years and were very fertile. In a second experiment plants were

topped at twenty leaves, but did not produce any more pounds per acre and the tobacco was much lighter in body. Topping at twelve leaves reduced the yield very materially, especially of the bright and red leaf grades. The custom in the dark district is to prime off about four leaves next to the ground and then top from eight to ten leaves on poor soil and from ten to twelve on fertile soil.

After topping the plant, suckers are produced at the axils of the leaves. The first crop of suckers appears soon after the plant is topped, the larger ones in the top of the plant. A short time after their removal a second crop appears. The suckers are removed when they attain a length of 3 or 4 inches. They should not be allowed to remain on the plants after they get of sufficient size to be easily removed. The building material that would otherwise go into the suckers should go to the production of leaf. Very large suckers will cause the leaves to break off by pushing them partially loose from the plant, and their removal leaves ugly scars where they were formerly attached, in which rot and fungous growths sometimes occur.

METHODS OF COMBATING INSECT PESTS.[a]

There are several blowing devices for applying Paris green to destroy insect pests. A simple one consists of a bellows duster that costs about $1. The operator should be careful to dust the poison on evenly and not excessively. Burning will occur in spots on the leaves, and sometimes the whole leaf is affected. From one-half to 1 pound of Paris green is sufficient to apply to an acre of Burley tobacco, the quantity depending on the size of the plants. A less amount should be used in the dark district. Paris green is effective in destroying young worms; but large ones are not held in check very much by it, so that hand picking must be resorted to. It is necessary to apply Paris green every ten days or two weeks in dry weather, and oftener in rainy weather.

Another method of combating the hornworm, and one which might be very successful if adopted by all of the tobacco growers, is the feeding of cobalt to the moths by applying it in the flowers of the jimson weed (*Datura stramonium*). The moths frequent these flowers during the evening twilight and suck the juices found in them; after they have taken some of this poison they become sick and die.

[a] A discussion of the insect enemies of tobacco is given in Farmers' Bulletin No. 120, entitled "The Principal Insects Affecting the Tobacco Plant," which may be obtained gratis on application to this Department. For further information in regard to these pests or methods for their control application should be made to the Bureau of Entomology, which is engaged in the special investigation of insects affecting this plant. Correspondence will be greatly facilitated if specimens of insects accompany letters of inquiry or complaint.

The cobalt solution should be made up at the rate of 1 ounce of cobalt to 1 pint of sweetened water. A few drops of this solution placed in the newly opened flowers each day will destroy the moths as fast as they appear. The jimson weed is sometimes set out around the field to entrap the moth in this way. Perhaps it would be better to set out the weed at some distance from the tobacco field, as moths in very large numbers seem to be attracted to the field by the flowers.

In the section referred to there are two periods when the worms are particularly numerous. The first visitation occurs early in July. The tobacco being small, as a rule no material damage is done. One month later a second visitation occurs that is much more serious, as the tobacco is large and the pests can conceal themselves with more ease.

SELECTION OF SEED PLANTS.

The selection of seed plants requires the grower's careful discrimination. The average farmer with a few acres should reserve ten or twelve choice plants for seed production. Out of this number he can save two or three that particularly suit his fancy. In a general way plants having leaves of good width and length are desirable. It does not follow that the biggest are necessarily the best, for coarseness is often correlated with size. The leaf should be thick and gummy and of good texture. The veins of the leaf should be far apart and at right angles to the midrib. The character of the veins should be observed and coarseness avoided. Coarse veins in the cured product injure its sale and limit the uses to which it can be put. Long internodes—distances between the leaves—are not desirable and are associated with coarse stalks, which are difficult to cure. It is commonly believed that it is better for the stalk to cure as soon after the leaf as possible. So long as the stalk is green it supplies moisture to the leaves, rendering them darker in color than they otherwise would be. In Burley tobacco, so far as color is concerned, the lighter colored green stalk is an indication of tenderness and that the tobacco will cure readily.

The seed plant should be selected by the time the "button" appears. All leaves except the number desired should be removed. A few days after the first selection the flowers will be blooming. A 12-pound manila paper bag should be placed over the head (fig. 8), so as to protect it from cross-fertilization. The procedure in bagging seed briefly alluded to here is based on the methods devised, developed, and introduced by the Bureau of Plant Industry. Details of these methods may be found in the Yearbook of the Department of Agriculture for 1904 in an article entitled "The Improvement of Tobacco by Breeding and Selection," by Mr. A. D. Shamel.

If any of the flowers have opened previous to bagging they should be removed, as in all likelihood they have been visited by insects and cross-fertilization has been accomplished. After the bags have been on about a week they should be temporarily removed and the seed head examined. All superfluous branches should be removed; also all small leaves, leaving only the "crow foot," bearing from forty to eighty pods. Weekly attention will be required as new blossoms, suckers, and leaves which require elimination are produced. The bags may be permanently removed after twenty-five days, but all flowers opening after the bags have been removed must be pruned off.

FIG. 8.—Seed head of a tobacco plant protected from cross-fertilization by a paper bag.

The maturity of the seed head is indicated by the pods turning brown. The heads can be taken from the field and hung up in a dry, well-ventilated place for drying. Precautions should be taken to prevent mice or birds from reaching them. Bagging is recommended because experimental evidence shows that self-fertilized seeds produce much more uniform and better plants than those promiscuously fertilized (fig. 9). Cross-fertilized seeds produce plants of widely varied characters, owing to the infusion of so many different strains. A certain plant is selected as an ideal; it is desirable to perpetuate its qualities. This can be accomplished only by excluding outside pollen. Darwin's experiments show that self-fertilized tobacco seeds have much greater prepotency than cross-fertilized seeds.

HARVESTING.

Ripeness of the plant is indicated by the appearance of yellow spots on the leaf and by the brittleness of the veins. Usually about thirty

days after topping, the plants are ready for harvesting. The stalks are split with a knife of the kind shown in figure 10, beginning at

FIG. 9.—Field of White Burley tobacco grown from seed matured under bag, only the heavy seed separated by machine being used.

the top and splitting to within 6 inches of the ground, and are cut from the hill just below the ground leaves.

Five or six plants, the number depending on their size, are placed astride a stick. Within four hours if the weather is favorable the plants will wilt enough to be taken to the barn. To prevent sunburn, it is often necessary to "scaffold" immediately after cutting. Tobacco can remain on the scaffold for two or three days, or longer if necessary. Rain will not damage it much if it has not commenced to cure. Tobacco that has yellowed well on the scaffold before taking to the barn is less likely to house-burn than if it is housed on the date of cutting, before it thoroughly wilts. In handling the crop all possible precautions are taken to prevent injury by bruising.

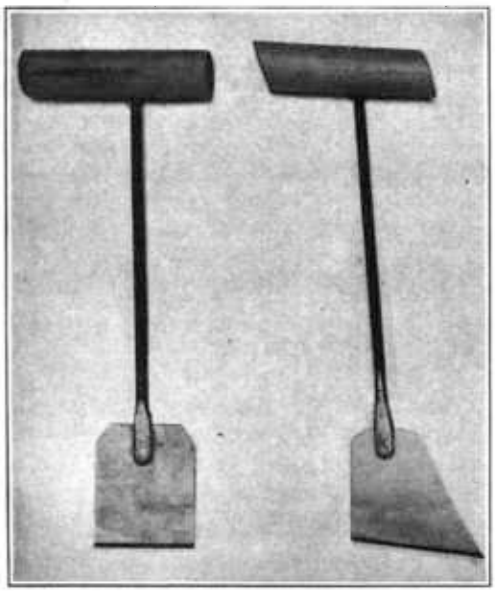

FIG. 10.—Knives used for cutting tobacco plants in harvesting.

A good frame for hauling tobacco is shown in the accompanying illustration (fig. 11).

CURING.

In the barn, sticks filled with the green plants are hung about 10 inches apart on the rails, which are usually 4 feet apart, these rails being about 4 feet apart vertically. Shaking the plants when they are being hung in the barn will prevent the leaves sticking together, which is a frequent cause of damage from house-burn, the texture and elasticity of the leaf being practically ruined when thus affected. Even if house-burn is not produced, uneven coloration is likely to result if the plants are not shaken.

The prime requisite of a barn for air-curing is that it shall be thoroughly ventilated (fig. 12). What is termed side ventilation is popular in the Burley district, i. e., the air is permitted to pass in

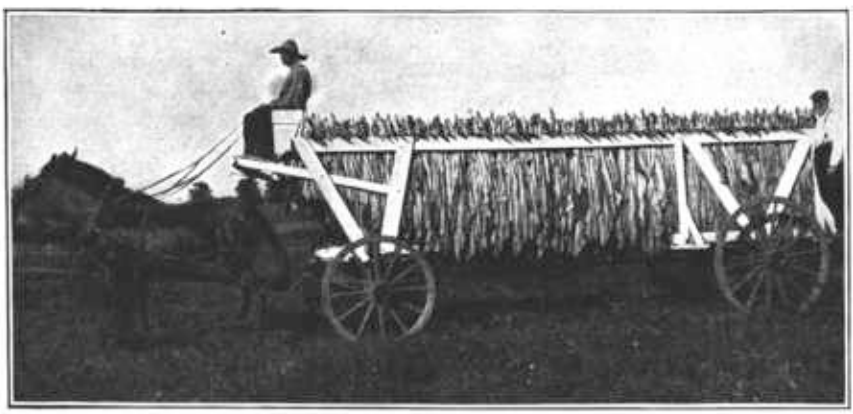

FIG. 11.—A good frame for hauling tobacco to the barn.

at windows on one side of the barn directly through and out of windows on the opposite side. The old method was designed to admit air at the side and provide an exit at the top. The movement of the air is effective in driving a current through the barn and is more likely to give good results than is dependence upon a rise of temperature to carry the draft out at the top. For the protection of tobacco hanging in the comb of the barn some ventilation at the top can be provided, since tobacco in this portion of the barn is not much affected by the side draft. To accomplish the ventilation desired, windows should be arranged horizontally the full length of the barn, parallel with each tier, so that a current of air may pass between the butts and the tips of the tobacco on each set of rails. The windows should be about a foot wide and the length of a bin, usually 12 feet. Ventilators about 2 feet square may be located every 25 feet in the comb of the barn.

The general principle upon which air-curing proceeds is that the tobacco dries during the day and comes "in case," or takes up moisture, during the night. The barn should be opened in the morning, kept open all day under normal conditions, and closed at night during damp weather. During dry weather while the tobacco is curing it is desirable to keep the barn open both day and night unless strong winds prevail which would break or bruise the tobacco.

The most trying time is during fogs and warm drizzling rains when there is very little air stirring. Under such circumstances the air on the outside is saturated with moisture and the barn should be kept closed until the air reaches the saturation point within, which

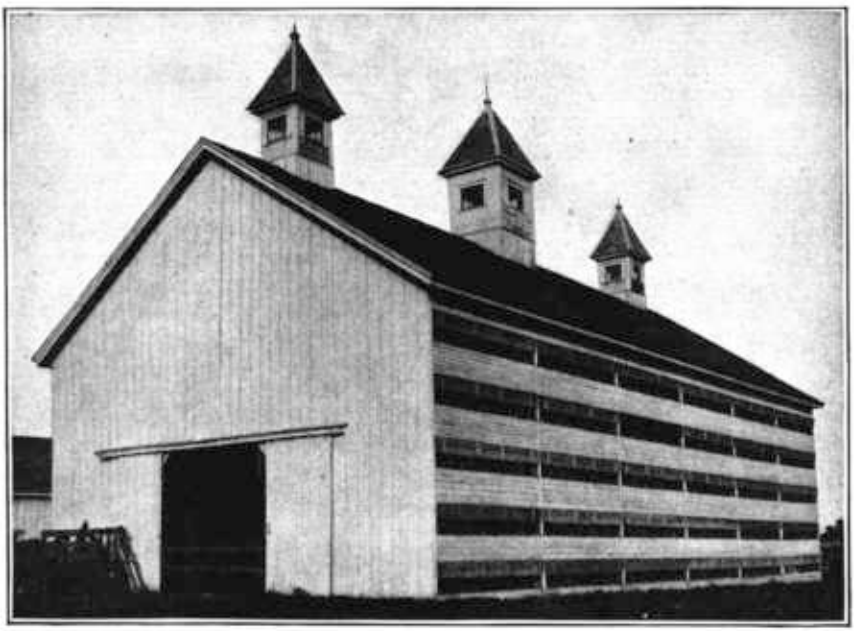

FIG. 12.—A well-ventilated barn for air-curing tobacco.

will be indicated by the sweating of the tobacco. Then it is better to open the barn and get the benefit of whatever draft there may be outside. Open fires of coke or charcoal are placed about on the floor of the barn whenever the draft is insufficient or the humidity so great that sweating continues. This creates a draft and increases the water-holding capacity of the inclosed air. Sweating may continue for forty-eight hours without serious injury, but if continued longer than this house-burn may occur and render fires imperative. The first two weeks is the critical period of curing; if no damage has been done at the end of that time the tobacco is comparatively safe. But even then, unless there is a very humid atmosphere, the barn should not be closed so tight that the air can not circulate through it. Two

months are ordinarily required before a crop is sufficiently cured to be bulked and stripped out.

In the dark-tobacco belt fire-curing is practiced. The sticks are crowded to about 6 inches apart on the tiers, the space being governed to some extent by the size of the tobacco, and very little regard is paid to ventilation. About five days after the crop has been housed (fig. 13) the yellowing process is completed and firing begins. If indications of house-burn should occur earlier it will be necessary to begin firing sooner than indicated. The first two or three days slow fires are applied so as to continue the yellowing process. Hotter fires follow until the curing process is practically complete.

FIG. 13.—A log barn still used for fire-curing tobacco.

The practice is quite common after about one week's firing to allow the tobacco to "run," i. e., to come in case, which will be facilitated by the amount of moisture still remaining in the stem and stalk. As soon as the tobacco is in case, slow fires are added again, but continued for only a short time. "Running" is not practiced as much as formerly by many of the best growers. A common mistake is made by attempting to cure the crop too quickly, and green and off colors are set. Careful planters often fire for about ten days. Wood—hickory and oak are preferable—is used in firing. The odor and flavor imparted to tobacco by the smoke of wood are necessary where an effort is made to produce a dark export type. Coke and charcoal

impart no flavors and for this reason are invaluable in emergency cases when Burley tobaccos are being cured.

STRIPPING AND GRADING.

Planters take advantage of rainy days during the winter to strip their crop. The moist air brings the crop in case so that it may be bulked in large piles; then it will not go out of case when fair days return. Care needs to be exercised not to bulk tobacco when it is not in case sufficiently, because it will be difficult to handle and breaking will occur. If tobacco is going out of case when bulked, it will continue to go out and become dry. Very high case must be guarded against, as tobacco will become very dark in the bulk, especially if much rainy weather follows. Bruising is likely to occur when tobacco in high case is handled. Tobacco bulked down in "winter order" during the winter months will funk during the months of April and May if not taken up and hung back in the barn to dry out. After June it can be taken down and bulked or prized in "summer order"; then it will keep for years.

Burley tobacco is assorted into five different grades, according to the color and body of the leaf. Beginning at the base of the stalk, the grades come in regular order as follows: Flyings, trash, lugs, bright leaf, and red leaf. The flyings are the light chaffy leaves at the base of the stalk; usually one or two leaves from each plant go in this grade. The trash is a little better grade than the flyings, and is usually of a bright color. The next grade is the lugs, which are of a bright color, and like the trash command the best price on the market. The bright leaf is the finest grade in appearance, but frequently does not sell for so much per pound as the trash and the lugs. From these bright grades already mentioned a special grade called "cigarette" is sometimes made. This includes only the best and brightest leaves, practically free from dark colors. Red leaf is the top leaves of the plant and is not so valuable as the bright leaf. The general principle to be observed is to secure uniformity of qualities within the same grade.

Dark tobacco is graded according to the same principle as Burley tobacco, but only three grades are made. This tobacco is usually topped at ten leaves; hence there is less opportunity for producing as many grades.

MARKETING.

Tobacco is sold either prized or loose. Selling loose is the less expensive way, and if markets and handling houses are near, farmers can readily take advantage of it. When the market is at a distance or it is desirable to reach a better market, the product can be packed in casks or hogsheads containing about 1,500 pounds. Only one

grade should be put in a hogshead; if it is necessary to put in more, they should be separated by a layer of paper. The more attention that is given to careful packing, so as to avoid a mixture of grades within the same bulk or cask, the more satisfactory sale returns will be received.

Tobacco packed during the winter, in winter order, will not keep through what is termed the May "sweat." To prevent it from funking and rotting during this sweating period one must take it up and dry it out, after which it may be repacked in June order; then it will keep indefinitely.

Burley tobacco is bought largely to supply the home market. It is used in the manufacture of smoking tobacco, cigars, and plug for chewing. Great Britain imports a considerable quantity of Burley tobacco for the manufacture of plug. The bright red leaf formerly furnished from the Green River district is now being supplied in part from the Burley district. Germany takes a considerable quantity of the inferior grades. Other European countries use limited amounts.

Fire-cured tobacco is superior to Burley in keeping quality. Dark tobacco packed in good condition during the winter months can be relied upon to pass through the May sweat. It is a good practice, however, to prize this tobacco in June order.

Dark tobacco is used mainly for export purposes and is particularly sought by English, German, Italian, French, Spanish, and African dealers. Sharp lines of distinction are hard to draw between many of the export types. Intermediate grades are generally sought by more than one market. Italian buyers would not hesitate to take certain Austrian grades if they could get them at Italian prices. If there is a shortage of Bremen tobacco, the manufacturers, through their representatives, at once proceed to buy the nearest approximation to the desired type.

In a general way the following classification applies to the export tobaccos: The English market takes grades varying in color from a bright red to a dark brown. The German market in former years preferred an article varying from a chocolate to a full brown color, rich and oily, of good body and strong, elastic texture. In later years there has been a growing demand for brighter colors. A strong, elastic texture is required for the English and German spinners, as the tobacco is twisted into a long coil after the fashion of a rope.

The Italian market takes grades ranging from a cherry red to a deep brown color, the better grades having a smooth, silky finish. The scale of qualities is represented alphabetically. *A* refers to the best grade and consists of a leaf from 25 to 26 inches long and of fine texture and fiber. This type is used largely for cigar wrappers. Grades *B* and *C* measure from 22 to 25 inches and from 18

to 22 inches, respectively, and approach the quality of *A* as nearly as possible. Intermediate grades are designated as *AB* and *BC*. These tobaccos are utilized mainly for cigars.

The types exported to Austria are regarded as of a higher class than the Italian and consist of grades of lighter shades of color. The Austrian type lacks the body of the Italian, but possesses superior finish and silkiness.

The wrapper demanded by the Swiss, which measures from 25 to 30 inches, is usually regarded as the highest development of the Austrian type.

The French and Spanish trades require the extreme of the light-bodied tobaccos. The better French classes command a very good price, while the Spanish is a cheap, nondescript tobacco.

The type of tobacco required in Africa consists of a very long, narrow leaf with plenty of body but coarse fiber and grain. Finish and quality are not considered. Tobacco for this trade is usually called "balers."

FARMERS' BULLETINS.

The following is a list, by number, of the Farmers' Bulletins available for distribution. The bulletins entitled "Experiment Station Work" give in brief the results of experiments performed by the State experiment stations. Titles of other bulletins are self-explanatory. Bulletins in this list will be sent free to any address in the United States on application to your **Senator, Representative, or Delegate in Congress,** or to the Secretary of Agriculture, Washington, D. C. Numbers omitted have been discontinued, being superseded by later bulletins.

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